

Recording a number of sets of data on a storage medium

TECHNICAL FIELD

The present invention is generally directed towards recording sets of data on a data carrier, for instance the recording of television programs, and in particular directed towards providing a method and device for recording multiple sets of data on a data carrier.

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BACKGROUND OF THE INVENTION

Programs in the form of video or audio are broadcast at present in a multitude of ways. Here it is sufficient to mention the Internet and over-the-air broadcasting. It has furthermore long been known to record data on different types of data carriers.

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When recording data, it is often common practice nowadays to code digital data using different coding algorithms. One such type of coding is the MPEG standard, where often MPEG1 or MPEG2 are used. In these standards it is possible to vary the recording quality by varying the bit rate of the data being recorded, which is often used for fitting a set of data to be recorded onto the recording medium. The actual space occupied is furthermore

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very hard to determine beforehand, because of the coding algorithms used.

In the art it is known to fit a recorded set of data to the size of the available space on a recording medium by allowing the recording quality to deteriorate.

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One such scheme is described in US 6,584,272, which describes the determination of an allowable recording time period for a set of data in the form of a program, given a certain free space up to the end of a disc or up to some point before the end of the disc in order to reserve some additional space. Given the available area of the disc, a maximum recording time period with a lowest quality, a shortest recording time with a highest recording quality and an average recording time with an average recording quality are indicated to a user. Depending on the length of time the user wants to be used for recording

and on different quality settings that can be applied by him/her, the user is informed whether the set of data can be recorded with the selected quality or not. This allows the user to either change the time of recording or the quality of recording, based on the remaining area on the disc.

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However, for a user the quality of the recording is often of secondary interest. Often it is more important to make sure that the recording is made and to allow the user not to have to decide between different recording qualities. A user might furthermore often program several programs to be recorded in one go and want them to fit into the available space without further involvement. In this respect the above-described scheme is not quite satisfactory since it is based on the recording of only one set of data at a time. Since the scheme is directed towards fitting one set of data to the disc, there might not be any space left for other sets of data on the same disc, since an optimization has been made only for one set of data.

Consequently, there is a need for a recording scheme which determines the available space and fits more than one program into this space.

SUMMARY OF THE INVENTION

The present invention is therefore directed towards solving the above-mentioned problem associated with fitting several sets of data into an available space of a recording medium.

One object of the present invention thus is to provide a method of recording multiple sets of data on at least one data carrier, which method is used to determine the available space and to fit more than one program into this space.

According to a first aspect of the present invention, this object is achieved by a method of recording multiple sets of data on at least one data carrier, comprising the steps of:

- reading program information regarding at least two different sets of data to be recorded on the at least one data carrier in a timed recording sequence, which information comprises the length of time used by each set of data when being played,
- calculating the recording length of all sets of data,
- determining the available recording space on the at least one data carrier for all unrecorded sets of data of the timed recording sequence,
- setting a recording quality for all sets of unrecorded data in the timed recording sequence that corresponds to a fitting of all sets of data to the available space,
- recording a set of data with the set recording quality, and
- repeating the steps of determining, setting and recording for each set of unrecorded data, until all sets have been recorded.

Another object of the present invention is to provide a device, which enables recording of multiple sets of data on at least one data carrier through determining the available space and fitting more than one program into this space.

- According to a second aspect of the present invention, this object is achieved
- 5 by a device for recording multiple sets of data on at least one data carrier, comprising:
- a recorder arranged to record at least two sets of data on the at least one data carrier,
 - a storage medium controller for receiving the at least one data carrier,
 - at least one program timer comprising program information regarding at least
- 10 two different sets of data, which information comprises the length of time used by each set of data when being played, and
- a control unit arranged to
 - read the program information regarding said at least two sets of data
 - which are to be recorded on said at least one data carrier in a timed recording sequence,
- 15 calculate the recording length of all sets of data,
- determine the available recording space on the at least one data carrier for all unrecorded sets of data of the timed recording sequence,
 - set a recording quality for all sets of unrecorded data in the timed recording sequence so as to enable all sets of data to be fitted to the available space,
- 20 order the recorder to record a set of data with the set recording quality, and
- repeat the steps of determining, setting and ordering to record for each set of unrecorded data, until all sets have been recorded.

- Claims 2 and 13 allow recording of a set of data with a fixed recording quality,
- 25 which allows a user to select a fixed, higher quality if he is interested in getting a good quality recording of one program.

Claims 3 and 14 are directed towards adding sets of data to be recorded to the timed recording sequence.

- Claims 4 and 15 are directed towards adjusting the timed recording sequence
- 30 because of a directly recorded program.

Claims 5, 6, 7, 16, 17 and 18 are directed towards different types of start and end markers on the at least one data carrier for determining the available recording space.

Claims 8 and 19 are directed towards moving the start marker in order to change the available recording space.

Claims 9 and 20 are directed towards removing program information about a set of data to be recorded, which allows an increase of the recording quality.

According to claims 10 and 21 the available storage space includes protected areas that split the timed recording sequence into fragments. Sets of data are then fit into
5 these fragments.

The present invention enables sets of data to be recorded such that they fit to an available recording space of at least one data carrier. The recording quality can furthermore be set to the highest possible recording quality. A user is furthermore relieved from having to be involved every time an actual recording is to take place; his involvement is
10 required only at the start of setting a recording sequence.

The basic idea of the invention is to determine the available recording space on at least one data carrier for all unrecorded sets of data of a timed recording sequence to be recorded on the at least one carrier, and to set the recording quality so that all sets of unrecorded data in the timed recording sequence fit to the available space, and to record a set
15 of data with the set recording quality, and to repeat the steps of determining, setting and recording for each set of unrecorded data, until all sets have been recorded.

The above-mentioned and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

20 BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be further described in relation to the accompanying drawings, in which:

Fig. 1 shows a block diagram of a device according to the present invention,
and

25 Fig. 2 shows a flow chart of a method of recording according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is generally directed towards the recording of a received
30 media data stream. The data is then often broadcast over different channels. Such broadcasts include, in the preferred embodiment of the invention, television programs broadcast on television channels, which can be normal airborne channels as well as satellite channels or cable TV channels or perhaps web TV channels. It is alternatively possible however that the broadcasting channels are different types of radio channels, such as web radio channels or

radio channels sent via air, satellite or cable. The broadcast information thus is media data in the form of programs, such as television or radio programs, as well as separate pieces of programs such as video or pieces of music. The recorder according to the present invention to be described is therefore an optical disc recorder of the Digital Versatile Disc (DVD) type, but it can also be another type of recorder like a hard-disc recorder or another type of recorder for just recording sound. It can furthermore be another type of optical disc recorder, like a Blu-Ray disc recorder or an HDTV recorder.

Fig. 1 shows a block diagram of a device for recording multiple sets of data on a data carrier according to the invention in the form of a recorder 10. The recorder 10 is connected to an antenna 12, which can receive information in the form of television programs broadcast by different television network operators. The antenna can be provided as a part of the recorder or as a separate entity to which the recorder 10 is connected. As television programs can be transmitted by means other than via the air, the recorder 10 does not have to be connected to an antenna 12, but can be connected to a satellite dish either directly or via a satellite receiver or to a cable of a cable supplier. The antenna 12 is connected to a receiver 14 within the recorder 10, which can be set to tune to different transmission frequencies. The receiver 14 also comprises an A/D converter for converting analog signals to digital signals. This A/D-conversion functionality would however not be needed if the signals were already digital. The receiver 14 is connected to a signal coding unit 16, which codes the digitalized television programs received by the receiver into coded sets of media data according to a suitable coding algorithm such as MPEG2 or MPEG1 and stores them on an optical disc 20 via a storage medium controller in the form of a disc controlling unit 18. The recorder 10 furthermore includes a control unit 22 controlling the coding unit 16, the receiver 14 and the disc controlling unit 18. According to the invention there is also provided a first program timer 24, a second program timer 26 and a third program timer 28, each connected to the control unit 22. It should be realized that there can be more or fewer program timers than shown in the Figure. There is furthermore provided a user input unit 30, for receiving information input by a user of the recorder 10. It should however be realized that information could just as well be input via a remote control communicating with an interface unit connected to the control unit 22, either in addition to or instead of the user input unit 30. The recorder 10 furthermore includes an information presentation unit, here in the form of a display 32, for showing visual information to the user. It should also be realized that the recorder does not have to present visual information to the user, because this information can just as well be audio information, in which case the recorder 10 does not need to include a

display. Visual information to be displayed to a user can also be displayed using a connected display device, like a television set.

The general operation of the device will now be described. The receiver 14 can be tuned to several different channels, all broadcasting information in the form of media streams or programs. A user of the recorder 10 can program a program timer 24, 26 or 28 for recording a program from any channel receivable via the receiver 14. When doing this the user can manually program for instance the first program timer 24 with settings for a first program to be recorded, this information including information about which channel is to be recorded, the start time of the recording and the end time of the recording. The user can also program the second program timer 26 for recording a program which is to be broadcast at a later time, and which is perhaps broadcast on a different channel. Also the third program timer 28 can be programmed in the same way. As an alternative to manual entry of this information into the first timer, the user can program the timer via an EPG (not shown). The information of channel, start time and end time is then present in the EPG and this information is transferred from the EPG to the corresponding program timer under the control of the control unit 22. All the user really has to do in this case is to select a program in the EPG and confirm the selection. Other alternatives of programming a timer are to transfer this information from teletext pages received via a channel. The control unit 22 then looks at the settings of the program timer 24 and controls the receiver 14 to tune to the programmed channel and the coding unit 16 to code the received program on the channel and store the program on the disc 20 via the disc controlling unit 18.

When doing this recording, it is necessary however to ensure that the programs can be recorded on the disc, i.e. that there is sufficient space for storing the information. This is not a trivial problem, since the coding techniques used today, for instance MPEG, which are efficient with respect to the amount of information stored, nevertheless use a coding for which it is difficult to know in advance how much space a recorded program actually occupies.

A preferred embodiment of the invention will now be described with reference to Figs. 1 and 2, where the latter shows a flow chart of a method according to the invention.

After a user has inserted a disc 20 in the disc controlling unit 18 and programmed the first, second and third program timer 24, 26 and 28 with program information relating to the recording of three different programs, the control unit 22 reads the settings of the timers; step 34. The settings include the start and end time of each program, from which information about the length of each program can be easily deduced. These

programs then make up a timed recording sequence regarding different sets of media data that are to be recorded. The control unit 22 subsequently calculates the total recording length based on these settings, i.e. the total time of these recordings; step 36. After that the control unit 22 determines the available recording space on the disc 20 for all the programs in the

5 timed recording sequence, which are all unrecorded at this stage; step 38. The available recording space is, in this case, the space from the position of a positional pointer in the form of a disc pointer to an end of disc marker. After this, the control unit 22 sets a recording quality or bit-rate for all the unrecorded programs in the timed recording sequence so as to allow these programs to fit on the available area of the disc 20; step 40. The recording quality

10 is, in this case, set as high as possible to enable fitting the programs on the disc. Thereafter the control unit 22 orders the recording of the first of the programs to be recorded according to the settings in the corresponding program timer with the set quality; step 42. In this example information about the first program in the sequence is provided by the first program timer 24, information about a second program in the sequence is provided by the second

15 program timer 26 and information about a third program in the sequence is provided by the third program timer 28. This is done through the control unit 22 making the receiver 14 tune to the channel in question and starting the coder 16 at the time set in the first program timer 24 and making the coder 16 end the coding process at the time set in the first program timer 24 and at the same time ordering the coder 16 to use the set quality. The receiver 14 then

20 receives the media stream and the coder 16 codes this stream for instance using MPEG1 or MPEG2. The coder 16 is then made to forward the coded program in the form of a set of data or a data file to the disc controlling unit 18, which stores the set of data or programs starting from the original position of the disc pointer. In the storing process, the disc pointer is continuously moved forward, step 44, until it reaches a position where the stored set of data

25 or media file ends. The control unit 22 now checks if there are more unrecorded programs in the timed recording sequence, step 46. If there are not, step 46, the recording process is ended, step 48. But if there are, step 46, the control unit 22 determines the available recording space on the disc, after this first recording, for the yet unrecorded programs, step 38, and sets the recording quality once again in order to fit the remaining programs on the disc, step 40.

30 This recording quality may be different than the one first used. Thereafter, the next program in the timing sequence is recorded based on the settings in the second program timer 26 with this new recording quality, step 42, and the disc pointer moved, step 42. In this way the control unit continues to check for available recording space and changes the quality of recording in order to fit programs into the available recording space until all the programs in

the sequence have been recorded and, in this example, until a program according to the third program timer 28 has been recorded.

In this way recording of programs is performed for several programs, while ensuring the best possible quality and fitting the recorded programs to the disc. Furthermore, the user does not have to be involved in the recording process any more than necessary and, above all, does not have to find out for himself whether a program will fit or not, which makes the invention very user-friendly.

The control unit is preferably provided in the form of one or more processors together with a corresponding program memory containing software code for enabling performance of the acts associated with the control unit. The program timers are normally provided as memory space. The coder can be provided in the form of hardware, perhaps as an ASIC circuit, but also in the form of software running on a computer, whereas the disc controlling unit is normally provided as hardware.

There are several variations that can be made to this basic concept of the invention. It is possible that the programs in the timed recording sequence cannot be fitted to the available recording space, in which case the control unit informs the user of this fact via the display. The user may then decide to remove a programmed recording in order to enable fitting to the available recording space. It is also possible that the control unit orders the recording of as much as possible of the last program in the sequence or removes portions at the beginning and/or end of the last recording. It can also select another recording to be truncated.

According to another possible variation, the user can set a certain fixed recording quality for a certain program. The control unit will then order the recording of this program with this fixed quality, while setting the recording qualities of the other programs such that they fit to the available recording space, with recording occurring at least at the lowest possible quality or bit-rate supported. In this way a user can select a good quality for a program in which he is most interested, while still allowing the other programs to fit to the available space on the disc. If possible, the timed recordings are recorded with the highest possible quality.

It is furthermore possible that the user can move the position of the disc pointer either backwards or forwards when initiating a timed recording sequence in order to extend or reduce the recording space. However, next, the control unit checks the program information in order to find out if all timed recordings can be recorded with at least the

lowest supported quality. If possible, the timed recordings are recorded with as high a quality as possible.

Yet another variation of the present invention is that the user can add a new recording by programming a timer after the timed recording sequence has been set. In this case the control unit checks if it is possible to add the new timed recording to the sequence, with at least the lowest possible quality being used for all programs that remain to be recorded. If it is possible, the addition is allowed, and otherwise the user is informed about the fact that it cannot be entered, or entered only if less than the totality of the programs in question is recorded. If it is allowed, the timed recordings are recorded with as high a quality as possible.

Another variation is that the user can decide to directly record a program without programming a timer, i.e. so-called one touch recording or direct recording. In this case the control unit checks, after the user selected program has been recorded, if the recording of the remaining programs in the timed recording sequence can be recorded with at least the lowest possible quality. If so, the timed recordings are recorded with as high a quality as possible.

Another situation that can occur is that the disc might have areas of protected recordings between the original position of the disc pointer and the end of disc marker. In this case, the available space is divided into fragments. When the control unit determines the available space of the disc, these protected areas are not taken into consideration. Furthermore, the qualities of the programs are selected to be such that the programs fit into the fragments, i.e. a consideration of the size of each separate fragment is made and the program for a fragment is selected based on whether it can fit into the fragment or not.

It is furthermore possible that the disc controlling unit receives several discs simultaneously. In this case, the fitting of programs to the available recording space according to the invention can be applied to all or some of these discs, according to the wishes of the user. Then the available recording space is defined by the disc pointer of the first disc and the end of disc marker of the last disc to be used for recording. The disc pointers and end of disc markers in between these markers then indicate fragments of the available recording space where programs can be recorded.

It is also possible that the user removes a program from the timed recording sequence. The free disc space is then added to the remaining available recording space and used for fitting the remaining programs of the timed recording sequence. This enables an increase of the recording quality.

The available space was defined hereinabove as the space provided between a disc pointer and end of disc marker. It is equally well possible that the user can select his own start and/or end markers to define the disc space available for recording. Hereinabove, the data carrier was described in relation to an optical disc. It should however be realized that the invention can also be used on other types of data carriers and storage mediums, like memory sticks, hard discs, memory cards etc.